Listing of Claims:

1. (Currently Amended) A fixing device of an image forming apparatus for thermally fixing a toner image formed on a transfer material, the fixing device comprising:

(a) a heating roller having a heating device; and

(b) a temperature detector which is spaced away from the heating roller, and which comprises: a surface temperature detecting sensor for detecting a temperature of a surface of the heating roller, a compensation temperature sensor for detecting an ambient temperature of the surface temperature detecting sensor, and a casing having an opening portion at a first position and a portion enclosed by the casing at a second position,

wherein the surface temperature detecting sensor is placed at the first position such that ~~heat radiation of the heating roller~~ the surface temperature detecting sensor is directly ~~incident~~ exposed to heat radiation of the heating roller through the opening, ~~to the surface temperature detecting sensor,~~ and the compensation temperature sensor is placed at the second position,

wherein the opening portion is disposed so as not to enter a region between a vertical plane containing a central axis of the heating roller and a tangential plane to a circumferential surface of the heating roller parallel to the vertical plane, and

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wherein a central portion of the surface temperature detecting sensor faces the central axis of the heating roller.

2. (Original) The fixing device of claim 1, wherein the second position is a position at which the heat radiation of the heating roller is not directly incident.

3. (Previously Presented) The fixing device of claim 1, wherein, for each of the surface temperature detecting sensor and the compensation temperature detecting sensor, an angle between (i) a straight line drawn from a central position of the sensor perpendicularly to the central axis of the heating roller, which represents a shortest distance between the central position and the central axis, and (ii) a plane containing a surface of the sensor, is 90 degrees ±5 degrees.

4. (Previously Presented) The fixing device of claim 1, wherein the casing for accommodating the two sensors of the temperature detecting device and a mounting member to be attached to the casing are made of a material having a good thermal conductivity.

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5. (Previously Presented) The fixing device of claim 1, wherein, except for an area exposed by the opening portion, the two sensors are covered by the casing.

6. (Original) An image forming apparatus comprising:

(a) the fixing device set forth in claim 1;

(b) a calculating device for calculating the surface temperature of the heating roller on the basis of outputs of the two sensors; and

(c) a controller for controlling a temperature of the fixing device according to the calculated surface temperature.

7. (Previously Presented) An image forming apparatus comprising:

(a) a fixing roller having a heater therein for fixing a toner image to a recording material;

(b) a temperature detector spaced apart from the fixing roller for detecting a temperature of the fixing roller and outputting a detected value of the temperature; and

(c) a temperature controller for controlling the heater to control the temperature of the fixing roller to be a preset temperature, based on a preset reference temperature and the detected temperature,

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wherein during a still state of the fixing roller the temperature controller controls the temperature of the fixing roller based on a first value for the reference temperature, and based on a second value for the reference temperature during rotation of the fixing roller, said second value being obtained by adding a preset correction value α to the first value.

8. (Previously Presented) The image forming apparatus of claim 7, wherein when the fixing roller is rotated at a rotation speed slower than a rotation speed thereof during said rotation corresponding to the second value, the temperature controller controls the temperature of the fixing roller based on a third value for the reference temperature obtained by adding a preset correction value β which is smaller than the correction value α to the first value.

9. (Original) An image forming apparatus comprising:

(a) a heating roller heated by a heating element;

(b) a roller heat detecting sensor for detecting heat radiated from the heating roller;

(c) an ambient temperature detecting sensor for detecting an ambient temperature of the roller heat detecting sensor;

(d) a surface temperature calculator for calculating surface temperature information of the heating roller; and

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(e) a heating controller for controlling the heating of the heating roller on the basis of the surface temperature information calculated by the surface temperature calculator,

wherein the surface temperature calculator calculates the surface temperature information of the heating roller by making the detection information of the roller heat detecting sensor and the detection information of the ambient temperature detecting sensor to be in association with data table information in which the surface temperature information of the heating roller corresponds to the detection information of the roller heat detecting sensor and the detection information of the ambient temperature detecting sensor is written, and calculates an average value of the plural values of the surface temperature information calculated.

10. (Original) The image forming apparatus of claim 9, further comprising a storage device having a register and a memory, wherein the memory stores the data table beforehand, and the register has a capacity storing three or more of either one of an average value of detection information of both the roller detection sensor and the ambient temperature sensor and an average value of the surface temperature information.

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11. (Original) The image forming apparatus of claim 9, further comprising:

a difference calculator for calculating a difference between detection information of the roller heat detecting sensor and detection information of the ambient temperature detecting sensor;

a comparing device for comparing an output value of the difference calculator with a predetermined value; and

an abnormal detector for judging that the output value is abnormal when the output value is greater than the predetermined value.

12. (Original) A control method of an image forming apparatus, comprising:

(a) calculating moving average values of detection information obtained by a roller heat detecting sensor for detecting heat radiated from a heating roller heated by a heating element and of detection information obtained by an ambient temperature detecting sensor for detecting an ambient temperature of the roller heat detecting sensor;

(b) calculating surface temperature information of the heating roller corresponding to both the calculated moving average values calculated from a data table in which the surface temperature information of the heating roller corresponding to

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the detection information of the roller heat detecting sensor and the detection information of the ambient temperature detecting sensor is written;

(c) calculating the average value of the calculated surface temperature information to obtain a roller surface temperature; and

(d) comparing the obtained roller surface temperature with the fixing roller target temperature; and

(e) controlling a temperature of the heating roller on the basis of the comparison result.

13. (Original) An image forming apparatus comprising:

(a) a heating roller heated by a heating element;

(b) a roller heat detecting sensor for detecting heat radiated from the heating roller;

(c) an ambient temperature detecting sensor for detecting an ambient temperature of the roller heat detecting sensor;

(d) a surface temperature calculator for calculating surface temperature information of the heating roller;

(e) a heating controller for controlling the heating of the heating roller on the basis of the surface temperature information calculated by the surface temperature calculator;

(f) a difference calculator for calculating a difference between detection information of the roller heat detecting sensor

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and detection information of the ambient temperature detecting sensor,

wherein the surface temperature calculator calculates the surface temperature of the heating roller by making output information of the difference calculator and the detection information of the ambient temperature detecting sensor to be in association with data table information in which the surface temperature information of the heating roller corresponding to the output information of the difference calculator and the detection information of the ambient temperature detecting sensor is written, and calculates an average value of the plural values of the surface temperature information calculated.

14. (Original) The image forming apparatus of claim 13, further comprising a storage device having a register and a memory, wherein the memory stores the data table beforehand, and the register has a capacity storing three or more of either one of an average value of detection information of both the roller detection sensor and the ambient temperature sensor and an average value of the surface temperature information.

15. (Original) The image forming apparatus of claim 13, further comprising:

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a difference calculator for calculating a difference between detection information of the roller heat detecting sensor and detection information of the ambient temperature detecting sensor;

a comparing device for comparing an output value of the difference calculator with a predetermined value; and

an abnormal detector for judging that the output value is abnormal when the output value is greater than the predetermined value.

16. (Original) A control method of an image forming apparatus, comprising:

(a) calculating a difference between output information obtained by a roller heat detecting sensor for detecting heat radiated from a heating roller heated by a heating element and output information obtained by an ambient temperature detecting sensor for detecting an ambient temperature of the roller heat detecting sensor through a difference calculator for calculating the difference;

(b) calculating a moving average value of the output information of the difference calculator and a moving average of the detection information of the ambient temperature detecting sensor;

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(c) calculating surface temperature information of the heating roller corresponding to both the calculated moving average values from a data table in which the surface temperature information of the heating roller corresponding to the output information of the difference calculator and the detection information of the ambient temperature detecting sensor is written;

(d) calculating an average value of the values of the calculated surface temperature information, thereby obtaining a roller surface temperature;

(e) comparing the obtained roller surface temperature with a fixing roller target temperature; and

(f) controlling a temperature of the heating roller on the basis of the comparison result.

17. (Original) An image forming apparatus comprising:

(a) a heating roller heated by a heating source;

(b) a detection sensor spaced apart from the heating roller sensor for detecting a surface temperature of the heating roller;

(c) a compensation sensor for detecting a temperature of the detection sensor;

(d) a storage device having an operation equation defined in correspondence with a region determined by the roller temperature range where normal printing is carried out;

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(e) a calculator for calculating the surface temperature of the heating roller on the basis of detection outputs of the detection sensor and the compensation sensor using the operation equation; and

(f) a controller for controlling an application of an electric current to the heating source on the basis of the calculation result and a target control temperature.

18. (Original) An image forming apparatus comprising:

(a) a heating roller heated by a heating source;

(b) a detection sensor spaced apart from the heating roller for detecting a surface temperature of the heating roller, wherein a roller temperature range in which a temperature of the heating roller is controlled, is undivided or divided into two or more temperature ranges;

(c) a compensation sensor for detecting the temperature of the detection sensor, wherein a detection output range of the compensation sensor is undivided or divided into two or more ranges;

(d) a storage device for storing respective operation equations defined in accordance with regions determined by the divided roller temperature ranges and the divided detection ranges of the compensation sensor;

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(e) a selector for selecting an operation equation corresponding to one of the regions including a target control temperature and the detection temperature of the compensation sensor;

(f) a calculator for calculating the surface temperature of the heating roller using the selected operation equation on the basis of detection outputs of the detection sensor and the compensation sensor; and

(g) a controller for controlling an application of an electric current to the heating source on the basis of the calculation result and the target control temperature.

19. (Original) An image forming apparatus comprising:

(a) a heating roller heated by a heating source;

(b) a detection sensor spaced apart from the heating roller for detecting a surface temperature of the heating roller, wherein a roller temperature range in which a temperature of the heating roller is controlled, is divided into two or more temperature ranges;

(c) a compensation sensor for detecting the temperature of the detection sensor, wherein a detection output range of the compensation sensor is undivided or divided into two or more ranges;

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(d) a storage device for storing respective operation equations defined in accordance with regions determined by the divided roller temperature ranges and the divided detection ranges of the compensation sensor;

(e) a calculator for calculating the surface temperature of the heating roller using the defined plural operation equations on the basis of a detection output of the detection sensor and the compensation sensor;

(f) a comparison judgment device for determining one having a smaller value to be a final surface temperature out of the plural calculation results; and

(g) a controller for controlling an application of an electric current to the heating source on the basis of the final surface temperature and a target control temperature.

20. (Original) The image forming apparatus of claim 18, wherein any one of the divided roller temperature ranges is a roller temperature range in which a normal printing is carried out.

21. (Original) The image forming apparatus of claim 17, wherein the operation equation is a linear operation equation.

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22. (Original) The image forming apparatus of claim 18, wherein the detection output range of the compensation sensor is a detection output range of the compensation sensor in accordance with the temperature range of the detection sensor to control the temperature of the heating roller.

23. (Original) A control method of an image forming apparatus, comprising:

(a) reading a detection output of a detection sensor for detecting a temperature of a heating roller and a detection output of a compensation sensor for detecting a temperature of the detection sensor;

(b) reading an operation equation stored beforehand for calculating a surface temperature of the heating roller set within a roller temperature range where normal printing is carried out;

(c) calculating the operation equation in accordance with the detection output of the detection sensor and the compensation sensor, whereby obtaining the surface temperature of the heating roller as a calculation result;

(d) comparing the obtained surface temperature with a target temperature; and

(e) controlling the temperature of the heating roller on the basis of the comparison result.

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24. (Original) A control method of an image forming apparatus, comprising:

(a) reading a detection output of a detection sensor for detecting a temperature of a heating roller and a detection output of a compensation sensor for detecting the temperature of the detection sensor;

(b) reading a plurality of operation equations stored beforehand for calculating a surface temperature of the heating roller set within a temperature range where a temperature control of the heating roller is to be carried out;

(c) selecting an operation equation corresponding to a target control temperature and a detection value of the compensation sensor out of the read operation equations;

(d) calculating the selected operation equation in accordance with the detection output of the detection sensor and the detection output of the compensation sensor, whereby obtaining a surface temperature of the heating roller;

(e) comparing the obtained surface temperature with a target temperature; and

(f) controlling a temperature of the heating roller on the basis of the comparison result.

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25. (Original) A control method of an image forming apparatus, Comprising:

(a) reading a detection output of a detection sensor for detecting a temperature of a heating roller and a detection output of a compensation sensor for detecting a temperature of the detection sensor;

(b) reading a plurality of operation equations stored beforehand for calculating a surface temperature of the heating roller set within a temperature range where a temperature control of the heating roller is to be carried out;

(c) selecting a plurality of operation equations corresponding to the detection values of the compensation sensor out of the read operation equations;

(d) calculating the selected operation equations in accordance with the detection output of the detection sensor and the detection output of the compensation sensor, whereby obtaining a smallest one out of the calculation results as the surface temperature of the heating roller;

(e) comparing the obtained surface temperature with a target temperature; and

(f) controlling the temperature of the heating roller on the basis of the comparison result.

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26. (Original) The control method of claim 23, wherein the operation equation is a linear operation equation.

27. (Original) An abnormal temperature detecting device of a fixing device of an image forming apparatus, for thermally fixing a toner image formed on a transfer material by a heating roller heated by a heating device, the abnormal temperature detecting device comprising:

(a) a temperature detector having a first temperature sensor for detecting a surface temperature of the heating roller and a second temperature sensor for detecting an ambient temperature of the first temperature sensor;

(b) a comparison device for comparing a detection signal value of the first temperature sensor with a preset reference value; and

(c) a judgment device for judging a temperature abnormality of the heating roller or an abnormality of the first temperature sensor on the basis of the comparison result.

28. (Original) The abnormal temperature detecting device of claim 27, wherein the judgment device judges that a detected temperature of the heating roller or the abnormality of the first temperature is abnormal in the case where a state that the detection signal value of the first temperature sensor does not

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exceed the preset reference value lasts for a period of time not shorter than a preset reference time as the result of the comparison.

29. (Original) An abnormal temperature detecting device of a fixing device of an image forming apparatus for thermally fixing a toner image formed on a transfer material by a heating roller heated by a heating device, the abnormal temperature detecting device comprising:

(a) a temperature detector having a first temperature sensor for detecting a surface temperature of the heating roller and a second temperature sensor for detecting an ambient temperature of the first temperature sensor;

(b) a differential amplification device for differentially amplifying a detection signal value of the first temperature sensor and a detection signal of the second temperature sensor to obtain a difference value; and

(c) a judgment device for judging that a detected temperature of the surface temperature of the heating roller or the ambient temperature of the first temperature sensor is abnormal in the case where a state that the difference value does not exceed a preset reference value lasts for a period of time not shorter than a preset reference time.

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30. (Original) An abnormal temperature detecting device of a fixing device of an image forming apparatus for thermally fixing a toner image formed on a transfer material by a heating roller heated by a heating device, the abnormal temperature detecting device comprising:

(a) a temperature detector having a first temperature sensor for detecting a surface temperature of the heating roller and a second temperature sensor for detecting an ambient temperature of the first temperature sensor;

(b) a differential amplification device for differentially amplifying a detection signal value of the first temperature sensor and a detection signal of the second temperature sensor to obtain a difference value; and

(c) a judgment device for judging that a detected temperature of the temperature of the heating roller or the ambient temperature of the first temperature sensor is abnormal in the case where a state that the detection signal of the first temperature sensor does not exceed a first preset reference value lasts for a period of time not shorter than a first preset reference time, in the case where a state that the detection signal of the second temperature sensor does not exceed a second preset reference value lasts for a period of time not shorter than a second preset reference time, or in the case where a state that the difference value does not exceed a third preset

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reference value lasts for a period of time not shorter than a third preset reference time.

31. (Original) The abnormal temperature detecting device of claim 30, wherein t1, t2 and t3 are set so as to satisfy the following inequality:

$t1 < t2 < t3$

where t1 represents the first reference time, t2 represents the second reference time, and t3 represents the third reference time.

32. (Original) An abnormal temperature detecting device of a fixing device of an image forming apparatus for thermally fixing a toner image formed on a transfer material by a heating roller heated by a heating device, the abnormal temperature detecting device comprising:

(a) a temperature detector having a first temperature sensor for detecting a surface temperature of the heating roller and a second temperature sensor for detecting an ambient temperature of the first temperature sensor;

(b) a differential amplification device for differentially amplifying a detection signal value of the first temperature sensor and a detection signal of the second temperature sensor to obtain a difference value; and

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(c) a positive-and-negative source voltage supply device for supplying a positive source voltage and a negative source voltage for making an operation region of the differential amplification device to cover a range extending from a negative voltage to a positive voltage to the differential amplification device; and

(d) a judgment device for judging that a detected temperature of the temperature of the heating roller or the ambient temperature of the first temperature sensor is abnormal in the case where a signal polarity of the difference value is negative.

33. (Original) The abnormal temperature detecting device of claim 32, wherein the judgment device judges that the detected temperature of the temperature of the heating roller or the ambient temperature of the first temperature sensor is abnormal in the case where a state that the signal polarity of the difference value is negative lasts for a period of time not shorter than a preset reference time.

34. (Original) The abnormal temperature detecting device of claim 27, further comprising a controller for controlling the heating device to stop once and to actuate later when the judgment device indicates an abnormality, and for judging the detected temperature of the temperature of the heating roller or

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the ambient temperature of the first temperature sensor to be abnormal when the judgment device judges again that the detected temperature is abnormal.

35. (Original) The abnormal temperature detecting device of claim 27, wherein the temperature detecting device further comprises a third temperature sensor placed at another position different from a placement position of the first temperature sensor, for detecting a surface temperature at the another position of the heating roller, and the abnormal temperature detecting device further comprising a confirmation device for confirming an abnormality on the basis of a detection signal value of the third temperature sensor and a third preset reference value.

36. (Original) The abnormal temperature detecting device of claim 35, further comprising a controller for controlling the heating device to stop once and to actuate later when the judgment device indicates an abnormality, and for judging the detected temperature of the temperature of the heating roller or the ambient temperature of the first temperature sensor to be abnormal when the judgment device judges again that the detected temperature is abnormal.

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37. (Original) The abnormal temperature detecting device of claim 28, further comprising a switching device for changing a length of the reference time set in the judgment device.

38. (Original) An image forming apparatus comprising the abnormal temperature detecting device of the fixing device as set forth in claim 27.

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